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XXVIII.—*The Reversed Under Wing-Coverts of Birds and their Modifications, as exemplified in the Birds of West Africa.* By George L. Bates, M.B.O.U.

(Text-figures 5–12.)

Introduction.

The two rows of feathers which form the subject of this paper are those called the major and the median under coverts of the wing, or the under coverts next to the remiges. The terms "major" and "median" were adopted doubtless on account of analogy with the upper coverts, but are not as appropriate in the case of the under as of the upper coverts, since, as will appear later, the major under coverts are often the smaller of the two series, and the median under coverts are often larger than either the major or the minor coverts, or in many cases smaller than either. The major and the median under coverts are distinguished from all the other feathers on the underside of the wing, in that they are placed facing downwards, or in the same position as the remiges; while all other feathers on the underside of the wing face upwards, in the opposite position to the remiges, *i. e.* stand face to face with them. Considered with reference to the remiges as a norm, it is these

other feathers, consisting of the minor and the marginal under coverts, that are *reversed*; but considered with reference to the position that seems most natural for the under surface of the wing,—the position of the majority of the feathers,—the two rows, the major and the median under coverts, are reversed: hence the term "reversed coverts" is applied to them. The fact of the peculiar position of the reversed coverts was pointed out by Sundevall (1), but his explanation of it must give place to that of Wray (2), which has since been generally accepted, and is here given in the author's own words (p. 353):—"These feathers or their antetypes were originally on the dorsal surface and have been carried down to the ventral in the formation of the 'ala membrana' by the excessive development of the remiges and tectrices majores." Wray noted that the embryo wing is rounded in section, there being no "ala membrana," and that the inferior major and median coverts are at first "distinctly more on the dorsal half of the rounded edge of the wing than its ventral."

When one becomes accustomed to thinking of the reversed coverts as really belonging to the upper surface of the wing, though pushed over to the under surface in the manner described, other facts besides their reversed position come to be understood. Sundevall (1) noted that "they often retain rigidity and straightness and an external form which give them some resemblance to quill feathers." It may be added that they sometimes resemble even in colour the remiges and upper coverts, and contrast with the minor under coverts. The reversed under coverts in the large Plantain-eater, *Corythæola cristata*, have their dorsal surfaces of the same beautiful blue colour as those of the remiges, though these surfaces lie flat against the bases of the remiges and upper coverts and are never exposed to the light, while the exposed ventral surfaces are dull black like those of the remiges, and like other feathers of the underside of the wing: thus the reversed coverts are brightly coloured exactly like the upper wing-feathers even though in their case the bright colour is never seen.

Practically nothing has hitherto been attempted in the way of particular descriptions of the various modifications of the reversed under coverts in different groups of birds. There is more on this subject in Sundevall's treatise (1) than in any succeeding memoir that I have seen. There it is stated as a universal fact, what will be seen in the sequel to be only generally true, that "on the cubitus the feathers of the first of these two series are firmly attached and just like the remiges, with the inner (posterior) margin free, covering the outer (anterior) margin of the next feather; but in the second series they are movable, and lie with the margins in the opposite direction to the former, so that the outer edge of each feather is free and covers the inner edge of the next one." Sundevall says he never found an exception to the above rule, and Pycraft (3) says the same thing; and they both add that the invariable overlap is a certain means of telling, when part or all of one series is absent, to which of the two series the remaining feathers belong. The numerous examinations of wings to be described in the following pages clearly show the above view to be wrong; the overlap is not invariable in either series of the reversed coverts, and is no certain criterion for deciding to which of the two rows any particular feathers belong.

In the space of two or three pages Sundevall describes the characteristic modifications of the reversed under coverts in quite a variety of birds. Of *Columba* he says that the major under coverts on the hand are "first interrupted, then again continued," while the median coverts upon the hand "seem to form a single row with" the major coverts. The facts as seen by him agree exactly with those found by me in other Doves, as described hereafter but are differently interpreted—the major coverts should really be regarded as one uninterrupted series on cubitus and manus, which changes its overlap on part of the manus; and the feathers which Sundevall describes as median coverts, "which seem to form a single row with" the major, are really major coverts overlapped the contrary way. Sundevall's slight observations on the reversed under coverts of other birds

likewise agree very well, as to the facts, with the detailed and extensive ones here to be recorded. He notes the varying tendency to be reduced in size, or to disappear, in the different parts of these two series of feathers. The different degrees of reduction or disappearance, together with variations in the overlap, as observed in different birds and groups of birds, with the manner of the derivation of one condition from another, so far as that may be traced, form the subject of the present paper.

Before leaving the literature relating to the reversed under coverts, it is proper to mention the important writings of Goodchild (4, 5) on a similar subject, the cubital upper coverts. In the different series of upper coverts on the cubitus he found variations characteristic of groups of birds, particularly as regards their overlap. He introduced and defined the terms "distal" and "proximal overlap," which have been used also by other writers since.

In the following pages another way of describing the overlap is employed, and the terms "distal" and "proximal overlap" are not used. I am aware that this terminology should not have been discarded without ample reason. My reason is that it is liable to ambiguity and confusion, in more ways than one, and that it not only may be, but has been, used differently by different writers. The first difficulty is that "distal overlap" does not tell us whether the distal edge is the one that covers the edge of the other feather, or the one that is covered by it. In the former sense it is used by Goodchild; but it is used in the latter (and opposite) sense by Gadow both in Bronn's 'Tierreich,' chapter on Pterylography (p. 558), and in Newton's 'Dictionary of Birds,' article "Tectrices" (p. 951). But still another chance for ambiguity arises, when the under surface of the wing is considered as well as the upper one, which alone was kept in view by Goodchild. Are we, then, to view the underside of the wing as if held in the hand or laid on a table, upside down, or in its natural position on the bird? The latter view can be taken only in imagination; but it is the consistent one if the whole of the feathering of the wing is to be thought of at once, as should certainly be

done when studying these reversed coverts, which properly belong to the upper surface of the wing, so that upper coverts, remiges, and reversed coverts may all be viewed alike. This was evidently the method of Pycraft, when he calls the overlap of the major under coverts, as of the remiges, "distal," and by Gadow when he calls the overlap of both "proximal." But if we view the wing as held upside down, the only way in which the reversed coverts can be actually looked at, the overlap of these must be described in the contrary terms to that of the remiges, though it is actually the same as that of the remiges.

In view of these manifold confusions, the terms "distal" and "proximal overlap" are not used in the following observations; but the simple method is employed of referring always to the remiges, with their invariable overlap, as a standard, and saying "overlap the same as the remiges" or "conforming to the remiges," or briefly "overlap conforming," and in the case of the other overlap "contrary to the remiges," or "overlap contrary."

A list of the publications referred to in this introductory portion of my paper is given here instead of at the end, since they are not referred to again; they do not pretend to constitute a full "bibliography."

(1) Sundevall, C. J. "On the Wings of Birds." (Translated from the Swedish.) Ibis, 1886, pp. 389–457. (Reversed coverts, pp. 418–421.)

(2) Wray, R. S. "On some Points in the Morphology of the Wing of Birds." P. Z. S. 1887, pp. 343–357.

(3) Pycraft, W. P. "Pterylography of Birds' Wings." Leicester, 1890.

(4) Goodchild, J. G. "Observations on the Disposition of the Cubital Coverts in Birds." P. Z. S. 1886, pp. 184–203.

(5) Same. "The Cubital Coverts of the Euornithæ." Proc. Roy. Soc. Edin. vol. x. 1890–91, pp. 317–333.

(6) Gadow, H. Bronn's Klassen und Ordnungen des Thierreichs. Vögel. Anatomischer Theil. 1891.

(7) Newton, A. Dictionary of Birds, 1893–96, article "Tectrices."

Detailed Examination of the Reversed Coverts in Various Birds.

The Normal Type.—One type of major and median under coverts is found in many large birds, belonging, for the most part, to orders that must be regarded as primitive or little specialized. In this type the major under coverts form a complete series, of large feathers, with a uniform conforming overlap; and the median series is complete on the cubitus and extends on the proximal part, sometimes as far as the middle of the manus, and consists of smaller feathers, all having the contrary overlap. In the following account, birds having this normal type of reversed under coverts will be given first, and the others will follow in an order intended to indicate roughly the amount of divergence from the normal type. The arrangement is not intended to be systematic—rather it is purposely not so, as the bearing of this examination on questions of phylogenetic classification must be left till the close.

Pteronetta hartlaubi. Eight specimens examined, including Nos. 5543, 5839 & 5840, the others not saved. (Text-fig. 5.)

The major under coverts all have the conforming overlap. The series is complete, there being one covert for each remex, and an extra one between the 4th and the 5th on the cubitus. The 11th or most distal one on the manus is just equal in length to its remex (the "remicle"), each being 30–33 mm. long; this covert hides the remicle which is very narrow.

The median under coverts form a complete row on the cubitus and extend to six feathers on the manus, besides another extra one that is exactly at the carpal joint, as in the accompanying diagram (text-fig. 6). These median coverts thus do not exactly correspond in position to the major coverts, but close upon one another and stand nearer together, to a slight extent.

The overlap of the median under coverts is contrary to that of the remiges, with the exception, at least in some

cases, of those nearest the elbow-joint. This exception was noted only in two or three of the last specimens examined; but I think it may have escaped notice in the others, since

Text-figure 5.

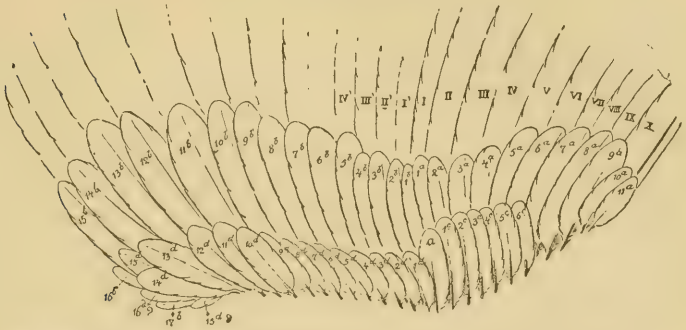

Diagram of the feather-arrangement of the underside of the wing of *Pteronetta hartlaubi*.

i-x. Primaries.
i'–iv', etc. Secondaries.
1^a–11^a. Manual major upper wing-coverts.
1^b–16^b. Cubital major u.w.c.
1^c–6^c. Manual median u.w.c.
1^d–16^d. Cubital median u.w.c.
a. Additional carpal median covert.

Text-figure 6.

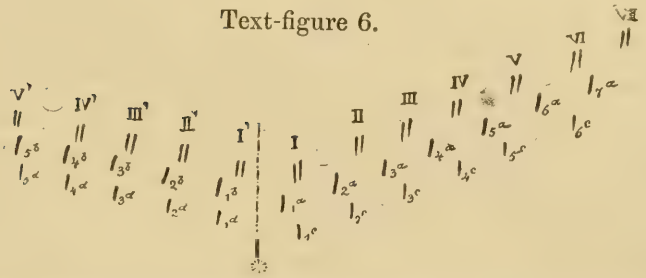

Diagram of the wing of *Pteronetta hartlaubi* showing the position of the extra median covert marked (*); other lettering as before.

at first I was accustomed to attribute any exceptional overlap to disarrangement. That the exceptional conforming

overlap of these feathers was not due to disarrangement in the cases where it was noted, is proved by the more extensive downy fringe on the distal edge of each, showing that that edge naturally lay covered.

Rhynchops flavirostris. One specimen examined, No. 5565.

Major under coverts a complete row, with the conforming overlap. The 11th on the manus is larger than its remex (the remicle).

Median under coverts with the contrary overlap, the row being complete on the cubitus, with in addition one just at the carpal joint and two wholly on the manus.

Totanus glareola. One specimen examined, No. 5646.

Major under coverts a complete row, with the conforming overlap. The 11th on the manus just equals the remicle.

Median under coverts with the contrary overlap, the row being complete on the cubitus, with three feathers on the manus.

Charadrius forbesi. One specimen examined, No. 5870.

Resembles in every respect *Totanus glareola.*

Actophilus africanus. One specimen examined, No. 5727.

Major under coverts with the conforming overlap; row complete, including the 11th on the manus, though I failed to find any 11th remex.

Median under coverts with the contrary overlap, the row complete on the cubitus, and one feather of this row on the manus.

Plotus rufus. One specimen examined (shot at Akonolinga, 12 January, 1914).

Major under coverts with the conforming overlap; row complete. There are also two small supernumerary feathers at the carpal joint, apparently in the row of the major coverts.

Median under coverts entirely wanting, unless, as is probable, the two small feathers at the carpal joint, just mentioned, are in reality a remnant of the median row.

The space between the quills of the 1st manual and the 1st cubital remex, in the wing of this Snake-bird, is very wide, as is also that between the corresponding major under coverts. Hence two small feathers of the median row, obsolete elsewhere, naturally persist in this vacant space and tend to close up into the major row.

Ardea goliath. One specimen examined, shot 9 September, 1916.

Major under coverts forming a complete row, with an extra one between the 4th and 5th cubital remiges; the 11th on the manus 62 mm. long, completely hiding the remicle, which is only half as long; those on the cubitus not very long, growing shorter towards the elbow. Overlap conforming on the cubitus; contrary on the proximal part, and conforming on the distal part, of the manus. The two wings differ a little in the extent of the portion of this series having the contrary overlap, this portion comprising the 1st to the 4th on one wing, and the 1st to the 5th or 6th on the other.

Median under coverts complete on the cubitus, there being one for each major covert; no extra one at the carpal joint, but one on the manus situated slightly to the distal side of the first manual major covert. (Overlap doubtless contrary, but not mentioned in notes.)

As this is the first case to be described of the exceptional contrary overlap in the major under coverts on the proximal part of the manus, it is proper to note: (1) that in this large bird, with the feathers firmly placed, there could have been no mistake; and (2) that it is impossible to regard these contrarily overlapped feathers as being really median coverts, because in this bird the median coverts form a very distinct row situated at some distance from the major, and extending on to the manus.

Nycticorax leuconotus. One specimen examined, No. 5608.

Major under coverts forming a complete row, those on the cubitus smaller than those on the manus, the 11th on the

manus (at tip of wing) longer than the 10th. Overlap conforming, with the exception of "some of them on the middle portion of the manus, which have the contrary overlap": thus the fact is stated in my note, and the additional remark is made "but they may have been disarranged." As this bird's wings were among the first examined, I still had the preconceived notion that all the feathers of each row must be overlapped alike.

Median under coverts complete on the cubitus and large, exceeding the major coverts, and near the elbow equalling, and in the case of the last two ones, the 17th and 18th, exceeding, the corresponding remiges; two of this row present on the manus. All are stated to have the contrary overlap.

Hieraaëtus lucani. One specimen examined, No. 5668.

Major under coverts, long feathers, forming a complete row, with eleven on the manus; overlap conforming.

Median under coverts forming a complete row on the cubitus, and extending on to the manus to one feather, besides one just at the joint. The feathers of this row are whitish, and short, being a little exceeded by the black minor coverts.

In all Accipitrine birds the under coverts have their bases hidden in a fluffy mass of down, and the median under coverts being small are often nearly hidden.

Urotriorchis macrurus. Two specimens examined, Nos. 5548 & 5802.

Major under coverts forming a complete row, with eleven on the manus (and the remicle lacking, at least in one of the specimens). Of the first examined of these two specimens, my note is, that the major under coverts have the conforming overlap; of the other, that two or three of these coverts on the proximal part of the manus have the contrary overlap.

Median under coverts found on the cubitus, and two (in one specimen) or one (in the other) on the manus. These coverts are small and loose feathers, but have the contrary overlap, so far as could be seen.

Dryotriorchis batesii. One specimen examined, No. 5602.

Major under coverts a complete row, there being fourteen on the cubitus and eleven on the manus; this 11th covert measured 24 mm. long, and the remicle only 20 mm. This row has the conforming overlap.

Median under coverts an apparently complete row on the cubitus, and two besides on the manus; these are small feathers and their overlap seemed to be *conforming*. If no mistake was made in this observation, it is very exceptional.

Lophoaëtus occipitalis. One specimen examined, not saved.

Major under coverts a complete row, with eleven on the manus, the 11th just equalling the remicle; overlap conforming.

Median under coverts forming a probably complete row on the cubitus and one only on the manus, besides one just at the joint; overlap contrary.

Astur melanoleucus. Six specimens examined, Nos. 5653, 5671, 5844, 5885 & 5899, and one other not skinned.

Major under coverts forming a complete row, fourteen or fifteen on the cubitus and eleven on the manus, the 11th always exceeding its remex. Overlap conforming on the cubitus and on the distal portion of the manus, but contrary on the proximal portion of the manus, usually about half the feathers of this row, from the carpal joint as far as the middle of the manus, having the contrary overlap, but sometimes more, sometimes less. The extent of the portion of the major under coverts on the manus having the contrary overlap varies, not only in different individual birds, but often in the two wings of the same bird; in specimen No. 5899, on one wing, about half of these coverts, from the carpal joint to the middle of the manus, have the contrary overlap, while in the other wing the whole of the manual major under coverts, to the tip of the wing, have the contrary overlap; but this condition was exceptional.

Median under coverts rather small, present on the cubitus with one feather, besides, just at the joint, or perhaps on

the manus ; no other found on the manus. From the fact that, in the last and most carefully examined specimen, some of the median under coverts seemed to be lacking also on the proximal part of the cubitus, it is possible that the row may frequently be incomplete in that portion; these small and loose feathers are hard to find amongst the abundant down. These median under coverts have the contrary overlap, where they are large enough to overlap at all.

Astur castanilius. One specimen examined, No. 5542.

Major under coverts forming a complete row ; overlap conforming on the cubitus and on only a small portion (two or three feathers) at the tip of the manus ; contrary on the remainder (the greater portion) of the manus.

Median under coverts on the cubitus, and two on the manus ; overlap contrary, as well as could be made out.

Astur sp., probably *A. tousseneli.* One specimen examined, No. 5785.

Major under coverts forming a complete row ; overlap conforming, excepting about six feathers on the proximal portion of the manus, which, in both wings alike, have the contrary overlap.

Median under coverts present on the cubitus and one on manus ; overlap contrary.

Kaupifalco monogrammicus. One specimen examined, No. 5628.

Major under coverts a complete row, with eleven on the manus, and the 11th remex, or remicle, absent; overlap of all conforming, so far as noted.

Median under coverts present on the cubitus and one just at the carpal joint, but none (or no other) on the manus ; overlap contrary.

Polyboroides typicus. One specimen examined, No. 5932.

Major under coverts forming a complete row, with eleven on the manus, the 11th and its remex being equal, 25 mm. long ; overlap of all conforming (this may be considered

certain, as this bird was one of the last examined, and any feathers with the contrary overlap would have been noted).

Median under coverts small and few. Only seven were found, all on the cubitus (the cubital remiges number fourteen) ; of these seven, the first four stand opposite, or a little distal to, the first four major under coverts, and the remaining three stand in like relation to the 6th, 7th, and 8th major coverts, leaving a gap opposite the 5th major under covert, and so just opposite the gap in the remiges. These small median under coverts do not have any overlap.

Buteo (?). One specimen examined, No. 5937.

Major under coverts complete, eleven on the manus, the 11th 30 mm. long, while its remex is 38 mm. ; overlap conforming, excepting four or five feathers on the proximal portion of the manus, which have the contrary overlap.

Median under coverts present on the cubitus, larger than in most of the Accipitres examined, the row ending distally with one feather just opposite the first major under covert on the manus.

As to the Accipitres in general, it may be said that most of them diverge from the normal type in their reversed under coverts by having a greater or less number of the major under coverts on the proximal part of the manus, from the carpal joint outwards, with the contrary overlap. This was found to be the case in every one of the numerous specimens belonging to the genus *Astur* ; of the specimens in which it was not found to be the case, some were examined about the beginning of this investigation, when I did not look so carefully for exceptionally placed feathers as I did later. The specimen of *Polyboroides typicus* certainly had the entire series conforming in overlap.

Syrnium nuchale. One specimen examined, No. 5905.

Major under coverts complete, eleven on the manus, the 11th equalling the remicle (24 mm. long) ; overlap of all conforming. This is the more certain since this bird was one of the latest examined.

Median under coverts present on the cubitus and the proximal half of the manus, the most distal one being opposite the 5th manual remex. These coverts are all rather small, and one or two at the distal end of the row are very small, with wholly downy vanes. The overlap of all is the contrary one.

Glaucidium sjöstedti. One specimen examined, No. 5770.

Major under coverts forming complete row, with twelve on the manus ! there being also twelve remiges, eleven large ones and the remicle ! ; overlap conforming on the cubitus and distal half of the manus, contrary on the proximal half of the manus.

Median under coverts present on the cubitus and on a little more than half of the manus, numbering six or seven manual ones besides one at the carpal joint ; overlap contrary.

The two specimens of Owls examined, belonging to different species and genera, differ in regard to the overlap of the major under coverts, one having them all conforming, the other having those on the proximal portion of the manus contrary, in the manner seen so frequently among the Accipitres. The two Owls agree, and differ from all the Accipitres, in the large number of median under coverts on the manus, in this respect departing less from the normal type than do the Accipitres.

The abnormal number of manual remiges and corresponding coverts in the specimen of *Glaucidium* is one of several like instances found among birds of different orders.

Psittacus erithacus. One specimen examined, not saved.

Major under coverts forming a complete row, with eleven on the manus. From the wording of the note on this point "an *extra* 11th one at the tip of the manus," it is probably intended that the remicle was wanting. Overlap of all of this row conforming.

Median under coverts present on the cubitus, but scarcely extending on to the manus, the most distal one being just at the carpal joint, a little proximal of the 1st manual major under covert; overlap of median coverts contrary.

Agapornis pullarius. Three specimens examined, two in male plumage and a female, none of them saved. (Text-fig. 7.)

Major under coverts a complete row of twelve or thirteen on the cubitus and eleven on the manus, the 11th 6 or 7 mm. long, and without any corresponding remex, or remicle.

Text-figure 7.

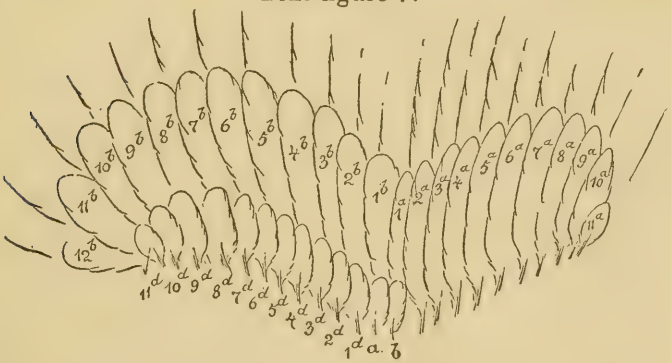

Diagram of the feathering of the underside of the wing of *Agapornis pullarius*. The remiges are only indicated.

1^a–11^a. Manual major u.w.c.
1^b–12^b. Cubital major u.w.c.
1^d–11^d. Cubital median u.w.c.
a carpal and *b* manual median u.w.c.

In my notes I was sometimes inclined to call this 11th under covert the remicle, but decided, I still think rightly, to consider it a covert; the feather in question has more the appearance of the comparatively broad and soft coverts than of the remicle, which is always narrow and stiff. Overlap of all major under coverts conforming.

Median under coverts a complete row on the cubitus, and one at the carpal joint and another on the manus; these

two are marked *a* and *b*. This number was found, however, only in the bird from which the sketch was made; in the others only *a* was present. Overlap contrary. The median under coverts are small and narrow feathers, hidden by the minor coverts. An interesting note was made in the case of the female bird, of the difference of colour between the reversed and the minor under coverts, the latter being green like the general plumage of the bird, while the reversed coverts were pale blue.

Poicephalus aubryanus. Two specimens examined, Nos. 5945 & 5946.

Major under coverts forming a complete row, with eleven on the manus, and the remicle wanting; overlap conforming.

Median under coverts present on the cubitus, with one or two on the manus or at the carpal joint, the two specimens apparently differing in this respect. Median coverts with contrary overlap.

It is noticeable that in none of the six specimens of Parrots belonging to three species and as many genera, were any major under coverts found with the contrary overlap, nor any median coverts with the conforming one. Further, very little variation was found in the extent of the median row.

There was in every case an 11th under covert at the tip of the manus, but no 11th remex, or "remicle."

Caprimulgus europæus [?]. One specimen examined, No. 5650.

Major under coverts forming a complete row, with eleven on the manus, and the remicle wanting (unless this "11th under covert" is the remicle instead, as seems unlikely); overlap conforming on the cubitus and distal portion of the manus, contrary on the proximal portion of the manus.

Median under coverts present on the cubitus, with one at the carpal joint, and one besides on the manus; overlap contrary.

Caprimulgus batesi. One specimen examined, not saved.

Major under coverts exactly as in the last bird, both as regards the number and the overlap; here also the remicle was wanting.

Median under coverts present on the cubitus, with one at the carpal joint, but no other on the manus; overlap contrary.

Caprimulgus binotatus. One specimen examined, No. 5942.

Overlap of the major under coverts on the cubitus and on the distal half of the manus conforming, on the proximal half of the manus contrary.

About the median under coverts no note was made except that they were small.

Scotornis climacurus. One specimen examined, No. 5645.

Major under coverts forming a complete row, with eleven on the manus and the remicle wanting; overlap of those on the cubitus, and of the most distal four on the manus, conforming; of the remainder on the manus contrary.

Median under coverts present on the cubitus, with the most distal one just at the carpal joint; overlap contrary.

Macrodipteryx macrodipterus. One specimen examined, No. 5783.

Major under coverts forming a complete row, with eleven on the manus, if the feather described in my note-book as "a remicle resembling the major under coverts" is really a covert, as I now think; overlap conforming, with the exception of six feathers on the proximal portion of the manus, on one wing only; on the other wing the overlap of the entire row conforming.

Note the marked difference, as regards the overlap of the manual major under coverts, between the two wings of the same bird, such as was seen in one specimen of *Astur melanoleucus*.

Median under coverts present on the cubitus, with one on the manus; overlap contrary.

Himantornis hæmatopus *. Two specimens examined, Nos. 5559 & 5859.

Major under coverts presumably corresponding in number to the remiges; that is, ten on the manus and twelve on the cubitus. Overlap contrary excepting two or three long coverts on the cubitus near the elbow-joint, which have the conforming overlap.

Median coverts not very small, present on the cubitus with one also on the manus. As to the overlap of these, the note on the first specimen is, "distal portion contrary to the remiges, proximal portion conforming"; that on the other specimen, "overlap contrary, as well as I could tell."

Wing in both specimens eutaxic.

Limnocorax niger. Three specimens examined, No. 5752, and two others not saved. (Text-fig. 8.)

Major under coverts corresponding in number, on the manus, to the remiges, there being ten of each; but in one specimen a very minute soft feather or semi-plume was found in the position of the remicle, and also a tiny 11th under covert. Overlap in all cases contrary, on both cubitus and manus.

Row of median under coverts very incomplete, but the number present varying somewhat in the different specimens and in the two wings of the same specimen. In one specimen, on one wing five median coverts were found, three on the cubitus (the 1st, 2nd, and 7th), one at the carpal joint and one very near it on the manus, and a still smaller number on the other wing; in another specimen the numbers present were six on one wing and eight on the other, the missing ones being those at the proximal end of the row, and the one that should stand in front of and a little distal from the 5th cubital major covert; in the note on the third specimen no statement is made of the number of median coverts present, but the absence of the 5th one on the cubitus is noted, as in the other specimen, and the position

* No better place was found to put the Rails than here; but the order of arrangement is not intended to be significant.

of the remiges and under coverts on the middle portion of the wing indicated by a diagram, here reproduced :—

Text-figure 8.

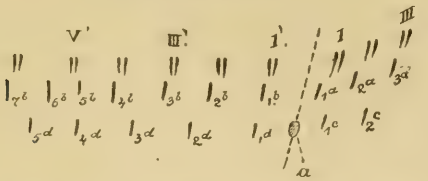

Diagram of the feather-arrangement of the underside of the wing of *Limnocorax niger*.

i–iii. Primary remiges; i′–iv′. Secondary remiges.
1^a–3^a. Manual major u.w.c.; 1^b–7^b. Cubital major u.w.c.
1^c–2^c. Manual median u.w.c. ; 1^d–5^d. Cubital median u.w.c.
a. Carpal median u.w.c.

Note.—This diagram will serve also to illustrate the position of the median under covert at the carpal joint and the one on the manus, so often referred to in these notes. If it be taken as the rule that the median covert on the distal side of the 1st major covert and directly in front of the 1st remex is the 1st median covert, then this one at the carpal joint is the 1st on the cubitus, and there is only one on the manus; but if the median covert on the proximal side of the 1st major covert be considered the 1st, then the one at the joint belongs to the manus, and there are two on the manus.

Sarothrura sp. No. 5639.

Major under coverts a complete row with probably ten on the manus (the number of manual remiges is noted as ten only) ; overlap contrary.

Median under coverts present on the cubitus, with one on the manus, or at the joint ; overlap contrary. The median coverts are inserted very close to the major, so that the two rows are a little hard to separate ; but the median coverts are much shorter than the others.

A remarkable fact about the two rows of reversed under coverts of this bird is that, though the wing is diastataxic as regards the upper coverts, with an extra one between the 4th and 5th cubital remiges, it is eutaxic as regards these under coverts, since they correspond exactly to the remiges—the major series as well as the median.

Sarothrura bonapartei. One specimen, No. 5958.

Major under coverts a complete row with undoubtedly only ten on the manus (only ten remiges were found); overlap of most contrary, but some at either end of the row, near the elbow and near the tip of the wing, apparently conforming in overlap.

Median under coverts present on the cubitus, with a small one at the joint or on the manus; overlap contrary, unless some of the coverts near the elbow have the conforming overlap, like the major coverts.

The wings of this bird also are eutaxic as regards the under coverts, though diastataxic as regards the upper ones.

Podica jacobi. One specimen, No. 5685.

Major under coverts a complete row, with probably eleven on the manus, and only ten remiges. (The note made at the time was thus expressed, "A remicle with white bar and white tip like the under coverts.") Overlap of these coverts on the manus contrary, on the cubitus apparently also contrary, but so interrupted by feathers in the moult that it could not be certainly made out.

Median under coverts present on the cubitus and one at the joint, or on the manus; overlap not made out.

Podica camerunensis. One specimen, No. 5943.

Major under coverts a complete row, but number on the manus not observed, though the presence of a remicle 9 mm. long is noted on each wing. Overlap contrary on the manus and distal third of the cubitus, conforming on the proximal two-thirds of the cubitus.

Median under coverts present on the cubitus, and one at the joint, or on the manus; overlap of all on the left wing, and of most on the right contrary, but that of some on the cubitus of the right wing conforming.

The wing in this bird was eutaxic.

The Rails (including *Podica*) are unique among the birds investigated in that, in every case, the whole or the greater part of the major under coverts have the contrary overlap.

The two rows of reversed coverts in the Rails are inserted close together, and have the same overlap.

Guttera plumifera. Six specimens examined, Nos. 5567, 5568, 5569, 5617, 5666 & 5667.

Major under coverts large, forming a complete row; the number on the manus undoubtedly ten, as an 11th would have been noted if found; overlap of the whole row, in all cases, conforming.

Median under coverts very small, not equalling the minor coverts which are themselves small; found only on the cubitus, or, in one case, on the cubitus with one at the joint and one on the manus besides. These coverts are so narrow and far apart as, in some cases, to have no overlap; but where the overlap could be made out, it was also conforming, like that of the major coverts.

Francolinus squamatus. Two specimens examined, not saved.

Major under coverts a complete row, about ten on the manus, and twelve on the cubitus; overlap conforming.

Median under coverts small, but not so small as in *Guttera,* present on the cubitus with one at the carpal joint; overlap contrary. An interesting fact noted about these small median coverts, in one of these Francolins, is that they have aftershafts.

Francolinus lathami. Three specimens examined, No. 5794, and two others which were not saved.

Major under coverts a complete row, ten on the manus. The overlap of these, in the first, and also in the last specimen examined, was found to be conforming throughout; in the other specimen all these coverts had the conforming overlap excepting three on the proximal end of the manus, in both wings alike, which had the contrary overlap.

Median under coverts in two specimens (they were inadvertently overlooked in the other) small, but not extremely small; present on the cubitus, with one at the

wrist joint, and another on the manus noted in one specimen. The overlap of these coverts in No. 5794 was found to be contrary, while in the last specimen examined it is stated to be undoubtedly conforming.

Though the birds of this group chance to come next after the Rails in this account, the characters of the reversed under coverts are widely different in the two groups. While in the Rails all or the most of these coverts, of both rows, assume the contrary overlap, in the Game-Birds the major coverts all, or in one case nearly all, have the conforming overlap, and there is even a strong tendency to the conforming overlap in the median coverts, a thing found in no other birds.

The great variability of the overlap of the median coverts in two of the three species here named is to be accounted for, perhaps, by the small size of these feathers, giving little margin for overlapping and allowing them to conform sometimes to the larger major coverts behind them.

The strong tendency to reduction in size of the median coverts in this group of birds is carried further in that which follows, so that the juxtaposition in this case is natural.

Corythæola cristata. Five specimens examined, none skinned.

Major under coverts a complete row, ten on the manus and fourteen on the cubitus ; overlap of all conforming.

Median under coverts entirely wanting. The presence is noted in three of the specimens of some small feathers or semiplumes, which from their situation were at first thought to be rudimentary median under coverts ; but upon closer examination they were found to have aftershafts on the side next the remiges, and hence could not belong to the reversed coverts.

Turacus persa. Four specimens examined, No. 5555, and three others not skinned.

Major under coverts a complete row, undoubtedly ten on the manus (the manual remiges number ten only) ; overlap of all conforming.

Median under coverts wanting. The same kind of very small feathers standing where a row of median coverts would be looked for, was found in this species as in the last, and here also they were proved to be minor coverts by the position of the aftershaft.

Turacus meriani. One specimen examined, No. 5560.

Major under coverts a complete row; overlap conforming.

Median under coverts none.

Centropus monachus. Two specimens examined, No. 5545 and another not saved.

Major under coverts complete, numbering ten on the manus and ten or eleven on the cubitus. The cubital portion of the row in both specimens, and in one specimen two or three coverts at the distal end of the manus, had the conforming overlap; the remaining coverts on the manus in the one specimen, and all on the manus, so far as noted, in the other, had the contrary overlap.

Median under coverts wanting.

Centropus anselli. Two specimens examined, Nos. 5577 & 5816.

Major under coverts a complete row, ten on the manus. The overlap of these, in No. 5816, was found to be conforming on the cubitus and distal part (about half) of the manus, and contrary on the proximal half of the manus; in the note on No. 5577 it is stated that the overlap was conforming only on the distal third of the manus, and contrary on the proximal two-thirds of the manus and also on the cubitus. That all the coverts of this row on the cubitus should have the contrary overlap is so improbable that I think it likely that only some of them on the distal end of the cubitus, next the contrary ones on the manus, were contrary in their overlap, as is the case in some Cuculidæ mentioned below, and that seeing some of them so arranged, I hastily concluded that all were so.

Median under coverts none.

Centhmochares aëreus. Three specimens examined, none of them saved.

Major under coverts, undoubtedly only ten on the manus (manual remiges only ten); overlap conforming on the cubitus and on the distal portion of the manus (sometimes more, and sometimes less than half), contrary on the proximal portion of the manus. In the last specimen examined it was noted that a few of these coverts on the distal end of the cubitus had the same contrary overlap as those adjacent to them on the manus.

No median under coverts.

Cuculus gabonensis. Four specimens examined, Nos. 5525, 5525, 5775 & 5803.

Major under coverts complete, undoubtedly ten on the manus; overlap conforming on the cubitus and distal end, sometimes only a small portion, of the manus, contrary on the remainder of the manus. In regard to the overlap in this species also, the first specimen examined seems to have been exceptional, in that it was found to have all the coverts of this row on the manus contrary; it is possible that two or three of the most distal ones may have been conforming, and the fact overlooked.

No median under coverts.

Cuculus solitarius. Two specimens examined, not saved.

Major under coverts complete, probably ten on the manus; conforming on the cubitus and on the distal third of the manus, contrary on the proximal two-thirds of the manus in the later specimen examined. In the first specimen of this species, which was one of the very first birds examined, all these coverts were thought to have the conforming overlap; probably some with the contrary overlap were overlooked.

Median under coverts none.

Cuculus [?]. No. 5931.

Major under coverts complete, doubtless ten on the manus (there were only ten manual remiges); overlap conforming

on the cubitus and distal two-thirds of the manus, contrary on the proximal third of the manus.

Median under coverts none.

Cercococcyx mechowi. One specimen examined, No. 5676.

Major under coverts complete ; overlap conforming on the cubitus and distal part, about half, of the manus, contrary on the proximal half of the manus.

Median under coverts none.

Pachycoccyx validus. One specimen examined, No. 5939.

Major under coverts complete, doubtless only ten on manus (there were only ten manual remiges) ; overlap conforming on the cubitus and distal half of the manus, contrary on the proximal half of the manus.

Median under coverts none.

Chrysococcyx cupreus. Five specimens, Nos. 5588, 5625 & 5877, and two which were not skinned.

Major under coverts complete, undoubtedly ten on the manus (manual remiges ten). As to the overlap of these, it is conforming on the cubitus, or at least the greater part of it, though sometimes some of these coverts on the distal end of the cubitus were found to be contrary like the adjoining ones on the manus ; it is generally conforming on the tip or distal part of the manus, and contrary on the proximal part, or sometimes the whole, of the manus.

Median under coverts none.

Chrysococcyx klaasi. Four specimens examined, Nos. 5883 & 5901, and two not skinned.

Major under coverts complete. They have the conforming overlap on the cubitus, excepting sometimes a few at the distal end ; and the conforming overlap, generally, on the distal part of the manus, and the contrary overlap on the proximal part, or in one specimen the whole, of the manus, with sometimes a few adjacent coverts on the cubitus.

Median under coverts none.

Chrysococcyx flavigularis. Three specimens examined, all in immature plumage, Nos. 5660, 5683 & 5878.

Major under coverts complete, ten on the manus (manual remiges also only ten), and nine on the cubitus; overlap conforming on the cubital and distal portion of the manus, contrary on the other part of the manus.

Median under coverts none.

Chrysococcyx smaragdineus. Eight specimens examined, Nos. 5611, 5642, 5670, 5882, 5889, 5911, 5913, and one not saved.

Major under coverts a complete row, numbering ten on the manus (remiges also only ten), and about ten on the cubitus. They are conforming on the cubitus except sometimes near the carpal joint; and on the distal part, sometimes more, sometimes less than half, of the manus; and contrary in overlap in the part of the row between, whether on the proximal part of the manus only, or on this with some adjacent feathers on the cubitus.

Median under coverts none.

In the large number of specimens examined, belonging to twelve species, of the Cuculidæ, there was never any trace of a second or median row of reversed under coverts; in this they agree with the Musophagidæ. But while in the last-named family the single row of reversed coverts always has the conforming overlap in its whole length, in the Cuculidæ there are generally two changes, and always at least one, in the manner of overlapping, between the base and the tip of the wing; the conforming overlap being found on the proximal portion or the whole of the cubitus, and generally also on the distal portion of the manus, while the feathers forming a continuous section of the middle portion of the row lying either wholly on the manus or on that and the adjacent part of the cubitus have the contrary overlap.

Vinago calva. Four specimens examined, none of them saved.

Major under coverts a complete row, ten (?) on the manus, and about twelve on the cubitus. Wing diastataxic. Those

on the cubitus are small feathers with downy edges, and are hidden by the larger median coverts. As to the overlap in this row, it is conforming on the cubitus, these small coverts having their distal vanes, which are almost wholly downy, covered not only by the edges of the adjoining coverts, but also by those of the remiges as well, so that they stand, each one sandwiched between the vanes of two remiges; on the manus the overlap is contrary excepting three or four coverts at the tip of the wing, which are conforming.

Median under coverts present on the cubitus, with one also at the carpal joint; overlap conforming. As these are larger than the major coverts on the cubitus, and have the same overlap as the major coverts on the manus, they appear to form a continuous row with the manual major coverts.

Turturæna iriditorques. Two specimens examined, Nos. 5846 & 5862.

Major under coverts complete (wing diastataxic), those on the cubitus small; overlap on the cubitus conforming, on the proximal part of the manus (half or less) contrary; on the distal part of the manus (half or more) conforming.

Median under coverts large, present on the cubitus, with one besides at the carpal joint, and still another (which was wanting, however, in one wing) on the manus; overlap contrary.

Calopelia puella. Two specimens examined, not saved.

Major under coverts complete, only ten on the manus (in one specimen there were found only ten manual remiges, in the other a very small 11th was found); on the cubitus the same number, twelve or thirteen, as the remiges, the wing being eutaxic. The coverts of this row on the cubitus are smaller than the median coverts. Overlap of major coverts conforming on the cubitus, contrary on the proximal part (half or less), conforming on the distal part (half or more) of the manus.

Median under coverts large, present on the cubitus, with one besides at the carpal joint; overlap contrary.

Tympanistria tympanistria. Three specimens examined, none saved. (Text-fig. 9.)

Major under coverts complete, ten on the manus, and on the cubitus the same number as the remiges, for the wing is eutaxic; these coverts on the cubitus small, with broad downy fringes at the edges, especially the distal edges. Overlap conforming on the cubitus; while on the manus, in the more carefully examined specimens, about half of

Text-figure 9.

Diagram of the under wing-coverts of *Tympanistria tympanistria* with the remiges only indicated.

1^a–10^a. Manual major u.w.c.
1^b–10^b. Cubital median u.w.c. which conceal the cubital major u.w.c.
a. Carpal median u.w.c.

these coverts on the proximal part of the manus were found to have the contrary overlap, and the other (distal) half the conforming one.

Median under coverts large, becoming near the elbow joint more than half as long as the remiges; present on the cubitus with one besides at the carpal joint; overlap contrary.

Chalcopelia afra. One specimen examined, not saved.

Major under coverts complete, ten in number on the manus, the 11th remex having no corresponding covert (? or remiges ten, and major under coverts eleven), thirteen on the cubitus, and wing eutaxic. Overlap conforming except on the proximal half of the manus, where it is contrary. These coverts are small on the cubitus, larger on the manus.

Median under coverts large, present on the cubitus, with one besides at the carpal joint on the manus ; overlap contrary.

In all the Doves examined the portion of the complete or major row of reversed under coverts lying on the proximal part of the manus was found to have the contrary overlap, as in so many other groups of birds. These under coverts differing in manner of overlapping from the others on the hand, were noticed by Sundevall in *Columba*. But he had laid down the rule that the feathers of "the second series" (median under coverts) "lie with the margins in the opposite direction to the former" (*i. e.* have the contrary overlap). This rule he considered so invariable that "when either of the two series is deficient, we can recognize by the position of the margins which it is that remains." Following this rule with *Columba*, he says that in this bird the first series (major coverts) is interrupted on the hand, their place being taken by the second series (median coverts). Against this view, that the feathers with contrary overlap are really median coverts filling a supposed gap in the row of major coverts, it may be argued :— (1) changes of overlap in the midst of either series of under coverts are frequent, in many different birds,—the overlap of each series is not uniform and invariable; (2) the feathers in question, on the proximal part of the manus, cannot be median coverts because there is one real median covert,— the feather marked "*a*" in the figure of *Tympanistria*— (two were found in *Turturœna*) in front of them, not in the same row with them. (See remark under *Ardea goliath*.)

The characteristic in which the reversed under coverts of Doves differ from those of the birds preceding them in this paper (but not from those following them) is the reduction in size of the major under coverts on the cubitus and the counterbalancing increase in size of the cubital median coverts, so that the latter become the principal under coverts of that part of the wing.

Apaloderma narina. Four specimens examined, No. 5663, and three others not saved. (Text-fig. 10.)

Major under coverts ten on the manus, and about nine or ten small ones on the cubitus, or else not so many, with one or two near the elbow lacking; wing eutaxic. These coverts on the cubitus are so small as to be hidden from view by the median coverts measuring 12–15 mm. in length, and

Text-figure 10.

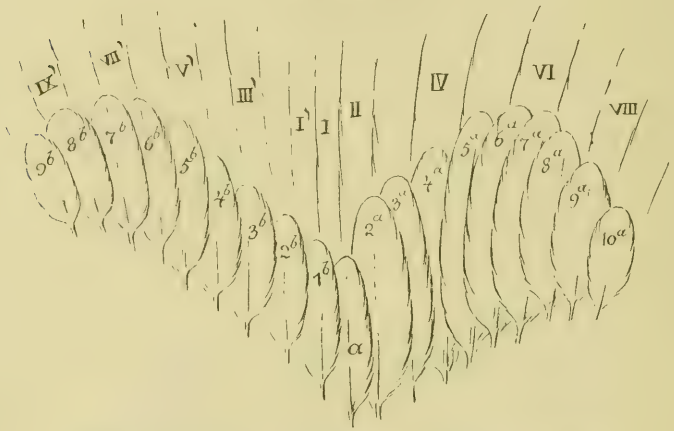

Diagram of the under wing-coverts of *Apaloderma narina*.

i–viii. Primaries; i′–ix′. Secondaries.
2^a–10^a. Manual major u.w.c.
1^b–9^b. Cubital median u.w.c.
a. Carpal median u.w.c.

The small cubital major and 1st manual major u.w.c. are concealed by the other larger feathers.

are soft and white; they have the conforming overlap, or rather each is wholly covered by the proximal edge of the next remex. The first major covert on the manus is also a small and hidden feather like those on the cubitus. The other major under coverts on the manus are large, and have the conforming overlap on half or more of this section of the wing, but the contrary overlap on the half or less, next the carpal joint.

Median under coverts present on the cubitus with one at the carpal joint; overlap contrary. These are not large, and the absence of visible major coverts behind them leaves the remiges bare for most of their length.

Eurystomus gularis. Four specimens examined, Nos. 5764, 5772, 5944 & 5950.

Major under coverts complete, if we include the rudimentary ones on the cubitus, which are scarcely more than down-feathers, though they have distinct shafts; eleven on the manus, the 11th being present even when, as in some of the specimens, the remicle was not found, and larger than the remicle when that was present. Wing diastataxic. The manual major coverts conforming in overlap excepting on the proximal portion (half or less) of the manus, where the overlap is contrary.

Median under coverts present on the cubitus, with one at the carpal joint; overlap contrary.

Ceryle maxima. Two specimens examined, Nos. 5626 & 5959.

Major under coverts present on the manus, number not noted (remiges eleven), but on the cubitus reduced to rudimentary feathers 20 mm. long, with slender shafts and weak downy barbs. Wing diastataxic, there being two of the rudimentary under coverts, as well as two of the large upper ones, between the 4th and 5th cubital remiges. Overlap of the manual major coverts conforming on half or more of the hand, but contrary on the proximal part (half or less). The major under coverts are coloured like the remiges.

Median under coverts present on the cubitus, with one at the carpal joint; overlap contrary. These are red like the minor coverts, and are so small as to be almost or quite hidden by them.

In this bird the reversed under coverts on the proximal part of the manus, though they have the same overlap as the median coverts next to them on the cubitus, do not

even appear to form a continuous series with them, being quite different in colour and size. This was not the case in the Trogon and the Broad-mouthed Roller described just before, for there the major coverts on the proximal part of the manus and the median ones next to them on the cubitus might easily be thought, from their appearance, to form one series.

Ispidina leucogaster. Two specimens examined, Nos. 5529 & 5583. (Text-fig. 11.)

Major under coverts present on the manus, ten in number; on the cubitus they are reduced to mere down-feathers, in

Text-figure 11.

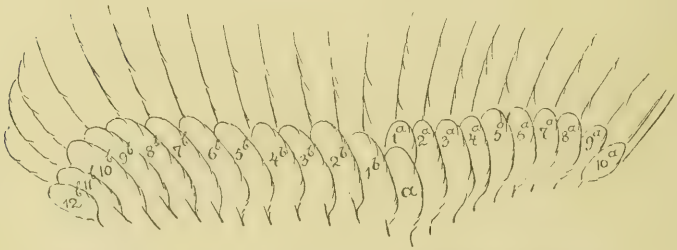

Diagram of the under wing-coverts of *Ispidina leucogaster*, the remiges only indicated.

1^a–10^a. Manual major u.w.c.
1^b–12^b. Cubital median u.w.c.
a. Carpal median u.w.c.

The cubital major u.w.c. are rudimentary and concealed behind the other feathers.

one bird without even shafts, in the other with slender shafts. Wings eutaxic. Overlap on the manus contrary, excepting, in the more carefully examined specimen, some on the distal or tip end, numbering five on one wing and only one on the other (the one shown in the figure), which are conforming.

Median under coverts present on the cubitus with one at the carpal joint; overlap contrary.

Ispidina picta. One specimen examined, not saved.

Major under coverts present on the manus, doubtless ten in number (remiges ten only); none whatever on the cubitus, not even rudiments. Overlap on the manus contrary, with the exception of two or three conforming ones at the tip. Wing eutaxic.

Median under coverts present on the cubitus, with one at the carpal joint; overlap contrary.

Myioceyx lecontei. One specimen examined, No. 5921.

Major under coverts present on the manus, doubtless only ten; on the cubitus represented by small down-feathers, so situated in the intervals between the remiges that each is closer to a remex on its proximal than on its distal side, thus differing from the usual position of major under coverts. Overlap on the manus contrary, with the exception of three to five conforming feathers at the tip.

Median under coverts present on the cubitus, with one at the carpal joint; overlap contrary.

Halcyon malimbicus. One specimen (immature) examined, not saved.

Major under coverts present on the manus; represented on the cubitus by rudimentary feathers, which, however, are not mere down-feathers, and have slender shafts. Overlap on the manus contrary on the proximal portion, conforming on the distal portion (about half).

Median under coverts present on the cubitus, with one at the carpal joint; overlap contrary.

Halcyon badius. Two specimens examined, No. 5906, and another not saved.

Major under coverts present on the manus, but represented on the cubitus by rudimentary feathers with slender shafts, or, in one of the specimens, by mere small down-feathers. Wing eutaxic. The manual major under coverts have the conforming overlap on the distal half, or more

than half, of the hand, the contrary one on the proximal half or less.

Median under coverts present on the cubitus, with one at the carpal joint ; overlap contrary.

In at least the smaller Kingfishers the reversed under coverts have the appearance, at first sight, of forming one continuous series on the two sections of the wing. That they do not really do so, is proved in the first place, by the extra one always found at the carpal joint, which is the continuation of the cubital series a little way past the end of the manual one, showing the former to be the median coverts; and in the second place, by the rudimentary major under coverts on the cubitus, sometimes large enough to be evidently the real continuation of the manual series, though sometimes they are mere small down-feathers and sometimes even quite absent.

Melittophagus müllerí. Three specimens examined, Nos. 5523, 5533 & 5766.

Major under coverts present on the manus, ten in number ; none on the cubitus, not even in a rudimentary condition. Overlap on the proximal portion (half or less) of the hand contrary, on the remainder half or more, conforming.

Median under coverts present on the cubitus, with one at the carpal joint noted in the last specimen, No. 5766—not noted in the others ; overlap contrary.

Melittophagus australis. Two specimens examined, Nos. 5562 & 5823.

Major under coverts present on the manus, none on the cubitus ; but in specimen No. 5823, on one wing only, a single small downy rudimentary feather near the first cubital remex seems to be a remnant of this series on the cubitus. Overlap on the proximal portion of the manus contrary, on the distal portion conforming.

Median under coverts present on the cubitus, with one at the carpal joint noted in the last specimen—not noted in the other ; overlap contrary.

Scoptelus brunneiceps. One specimen examined, a male in immature plumage, No. 5879.

Major under coverts entirely wanting.

Median under coverts present on the cubitus only, where they form with the minor coverts a single row of about sixteen feathers very close together, with one continuous overlap (the contrary one). The reversed and the minor coverts of the single row can be distinguished only by noting that every alternate feather is turned face towards the remiges, while the remainder are reversed.

Bycanistes albotibialis. One specimen examined, not saved.

Apparently no reversed under coverts whatever. There is a row of well-developed minor coverts extending the whole length of the wing, and behind these and hidden by them, on the cubitus, two rows of small downy feathers with stiff and peculiarly flattened shafts, the two rows so close together as to form a single numerous row with continuous contrary overlap. These were found to have the more convex and glossy side of the rhachis turned from the remiges, and were thought therefore to be minor coverts. It is possible that a closer examination might have shown the alternate ones to be reversed, as was afterwards found in the specimen of *Scoptelus* (see above).

Bycanistes sharpei. One specimen examined, No. 5623.

Probably no reversed under coverts. This specimen had behind the fully-developed minor under coverts on the cubitus some small feathers which were mostly in moult, and those not in moult were too small for me to determine whether they were reversed or not.

Lophoceros fasciatus. One specimen examined, not saved.

No reversed under coverts that were certainly known to be such. Two small feathers standing close to the 11th and 12th cubital remiges, near the elbow, seemed to be reversed, but I could not be sure. A row of minor under coverts somewhat resembling the peculiar small ones noted in the

large Hornbills above was found in this bird also, but they were not so markedly different from the other minor coverts.

Lophoceros camurus. Two specimens examined, Nos. 5900 & 5908.

No reversed under coverts, or only rudimentary ones. In one specimen five, in the other two, small downy feathers were found on the proximal end of the cubitus, that seemed, from their situation, to be reduced reversed coverts; but it could not be determined which side was the front and which the back of any of them. The minor under coverts also small and downy.

Lophoceros hartlaubi. One specimen examined, No. 5807.

No reversed under coverts that could be known to be such. All under coverts very small.

Orthlophus cassini. Two specimens examined, No. 5590, and another not saved.

No reversed coverts that could be determined to be such. Two rows of small coverts were found on the cubitus with downy vanes and peculiar broad flattened shafts, each row with the feathers closer together than the remiges, and the two rows very close to each other. No certain difference could be seen between the two sides of these little feathers, the shafts being perfectly flat, without convexity or groove—or perhaps the side away from the remiges was slightly convex. This fact, if it was such, and also the crowded situation of these little feathers, such that they did not correspond to the remiges, seemed to show them to be minor coverts.

In the Hornbills, reversed under coverts seem to be either entirely wanting, or reduced to rudimentary feathers. Further study with a microscope would doubtless make it possible to determine the homology of the small and peculiar under coverts that were found. The greatly reduced under wing-coverts form but one feature of the general sparse or reduced pterylosis of the Hornbills.

Lybius bidentatus. Four specimens examined, No. 5635, and three others not saved.

Reversed under coverts forming one continuous row on both parts of the wing, without anything in their appearance or situation to show that they belong to different series, there being no extra one at the carpal joint; they number about twelve on the cubitus, and I think ten on the manus, as an under covert of the remicle would have been noted if one had been present. Overlap of these coverts contrary on the cubitus and the adjacent part of the manus, conforming on the remainder, from half to three-quarters, of the manus.

Tricholæma flavipunctatum. One specimen examined, No. 5902.

Reversed under coverts one continuous row with no extra one at the carpus ; overlap contrary excepting on the distal half of the manus, where it is conforming.

Gymnobucco peli. One specimen examined, not saved.

Reversed under coverts one continuous row with no extra one at the carpus, numbering ten on the manus and about twelve on the cubitus ; overlap of those on the cubitus and the next two on the manus contrary, of the remainder on the manus conforming.

Buccanodon duchaillui. Three specimens examined, No. 5549, and two others not saved.

Reversed under coverts one continuous row with no extra one at the carpus, numbering doubtless ten on the manus, and about twelve on the cubitus ; these latter and the next ones on the manus contrary in overlap, the remainder, varying in number from eight to five, of those on the manus conforming.

Barbatula stellata. Three specimens examined, not saved.

Reversed under coverts one continuous row with no extra one at the carpus (unless overlooked) ; overlap contrary excepting the distal half of the manus, where it is conforming.

Barbatula leucolaima (six specimens) and *B. subsulphurea* (five specimens).

Reversed under coverts one continuous row, with no extra one at the carpus noted—certainly none in some cases; number on the manus ten, on the cubitus about ten; overlap contrary, excepting on a varying fraction, usually half or more, of the manual part of the series at the distal end, where it is conforming.

Barbatula erythronota. Seven specimens examined, Nos. 5644, 5824, 5841, 5909, 5929, 5930 & 5936.

Reversed coverts present on the cubitus and on the manus, without anything, in most cases, to show that the two portions of the single row belong morphologically to different series; but in No. 5824 an extra reversed under covert at the carpal joint was found on both wings, and again in No. 5929 such an extra one was found on one wing only. This extra covert is in front of, and smaller than, the 1st covert on the manus, like that marked *a* in the figure (p. 560) of the Kingfisher (*Ispidina leucogaster*), and it seems to be an indication that the cubital reversed coverts in the Barbets, as in the Kingfishers, are really the median coverts which, though generally confined to the cubitus, occasionally extend distally by one more feather, thus continuing the row a little past the end of the major coverts on the manus. Overlap of these cubital or median coverts contrary, as is also that of the proximal end (half or generally less than half) of the manual or major coverts; of the remaining major coverts, on the distal half, or more, of the manus conforming.

Trachylæmus purpuratus. Two specimens examined, not saved.

Reversed under coverts forming an apparently continuous row, with ten on the manus and ten or eleven on the cubitus; no extra one noted. Overlap contrary, excepting those on the distal portion, half or more, of the manus, which are conforming.

Though in the Barbets there is found only a single apparently continuous row of reversed coverts and the rudi-

mentary major under coverts found on the Kingfishers and Bee-eaters have quite disappeared, and the extra carpal reversed covert, or most distal median covert, has in most cases disappeared also ; yet the occasional presence of this feather, as well as the analogy of the Kingfishers, shows that the cubital portion of the single row consists of median coverts, and the manual portion of the major coverts.

Indicator exilis. One specimen examined, No. 5880.

Reversed under coverts one continuous row on cubitus and manus, with no extra one at the carpus; number on the manus undoubtedly nine only, as only nine manual remiges were found. Overlap of these under coverts contrary, excepting a few on the distal end of the manus, which are conforming.

With regard to the point of junction of the manual and the cubital reversed under coverts, a more exact note was made on this specimen than on most. The position of the 1st cubital under covert is in front and rather to the distal side of the base of the first cubital remex (and so also of all the series on the cubitus), thus making two coverts in the interval between the bases of the 1st manual and the 1st cubital remiges, although neither is in front of the other as with the extra covert at the carpus frequently noted. Though, unfortunately, notes on this point were not made in other cases, it is probable that this position of each cubital under covert rather to the distal side of its remex is the universal one in this and allied birds, and if so this is an additional indication that these are the median and not the major coverts. The position of each manual reversed covert on the proximal side of its remex is likewise an indication that the manual ones are the major coverts.

[Note the positions, where both series of reversed coverts are present, in diagram under *Pteronetta hartlaubi,* p. 535.]

Prodotiscus insignis. One specimen examined, No. 5768.

Reversed under coverts one continuous row, with contrary overlap excepting the distal half of the manus, where the overlap is conforming.

Melignomon zenkeri. One specimen examined, No. 5566.

Reversed under coverts one continuous row, numbering undoubtedly only nine on the manus, as there were only nine functional manual remiges, the 10th being only 4 mm. long; overlap of these under coverts contrary, excepting the most distal three on the manus, which were conforming.

Melichneustes robustus. One specimen examined, No. 5576.

Reversed under coverts one continuous row, numbering nine only on the manus (and functional remiges also only nine, the 10th being only 4 mm. long); overlap of reversed under coverts contrary, excepting the most distal three on the manus, which were conforming.

Iynx. No. 5624.

Reversed under coverts one continuous row; those on the cubitus and the next two on the manus with the contrary overlap, the remainder on the manus with the conforming overlap.

Verreauxia africana. Five specimens examined, Nos. 5652, 5917, and three others not saved.

Reversed under coverts one continuous row, numbering ten on the manus and nine or ten on the cubitus; no extra one present at the carpus (but in the first specimen no note was made on this point); overlap contrary on the cubitus and on half or more of the manus, conforming on the distal half, or less, of the manus.

Dendromus caroli. Six specimens examined, No. 5920, and five others not saved.

D. nivosus. One specimen examined, not saved.

D. permistus. One specimen examined, No. 5791.

Reversed under coverts one continuous row, numbering ten on the manus and about the same number on the cubitus; no extra one noted at the carpus; overlap contrary on the cubitus and adjacent portion—often only a small portion—of the manus, conforming on the remainder.

Mesopicus ellioti. Four specimens examined, Nos. 5541, 5640, 5884, 5907.

M. xantholophus. Two specimens examined, Nos. 5887, 5903.

Reversed under coverts one continuous row, numbering ten on the manus and about ten on the cubitus; no extra one noted at the carpal joint; overlap contrary on the cubitus and adjacent portion of the manus, conforming on the remaining portion—half to one-third or three-quarters—of the manus.

Dendropicus gabonensis. One specimen, No. 5627.

D. lafresnayi. Three specimens, Nos. 5536, 5881, and another not saved.

In these four specimens the reversed under coverts may be described in identical terms with the other Woodpeckers above; in the one specimen of *D. gabonensis* the distal portion of the series, having the conforming overlap, comprised nearly all of these coverts on the manus on one wing and scarcely half on the other wing.

Though in the Woodpeckers the reversed under coverts always form but a single series, apparently continuous on the two parts of the wing, without even the extra median covert at the carpal joint, yet analogy drawn from the preceding groups leads us to consider the series as made up of the remnant of two series, the coverts on the manus being the major, while those on the cubitus are the median coverts. There seems to be a small but pretty constant difference separating the Woodpeckers from the Barbets and Honey-Guides, in regard to the place of the change of overlap on the manus; in Woodpeckers at least half of the manual reversed coverts are conforming (the only exception being found in some specimens of *Verreauxia*), while in the other groups named often only a small portion at the distal end is conforming.

Colius nigricollis. Seven specimens examined, No. 5869, and six others not saved.

Reversed under coverts one continuous row, numbering

ten on the manus and eight or nine on the cubitus; overlap on the cubitus and the adjacent part of the manus contrary, on the rest of the hand conforming. The proportion of these coverts on the manus with the conforming overlap varies greatly, being often about half but sometimes much less, and on one wing of one bird none at all; while sometimes it is more than half, and in one specimen apparently all these coverts were conforming.

Tachornis parvus. Seven specimens examined, No. 5763, and six others not saved.

Reversed under coverts large, in one continuous row, of ten on the manus and about eight on the cubitus. Wing eutaxic. In my notes I have recorded the presence of a remicle or 11th manual remex, having no corresponding under covert, and it is possible to consider this little terminal feather as really an 11th under covert, as was certainly the case in some birds having no remicle. Overlap of all reversed under coverts conforming.

Chætura sharpei. Two specimens examined, Nos. 5786 & 5843.

Reversed under coverts forming one continuous row, numbering ten on the manus and about seven on the cubitus, with a small one besides at the carpal joint, in front of the row of the others. Wing eutaxic. Here again the presence of a remicle was noted, with the additional words, in one case, "resembling the major under coverts," and possibly this is to be considered as an 11th reversed under covert on the manus. Overlap of all reversed coverts conforming.

This group (the Swifts) seems to be out of its place, with regard to the morphology of the reversed under coverts, when put here next to the Coraciiform birds. For if we consider the single series of these coverts to be made up of the major coverts on the hand and the median ones on the fore-arm, as in the preceding groups, then we have median coverts with the conforming overlap and cubital major coverts absent, which is improbable. Besides, the smaller extra

reversed feather at the wrist-joint, found in the two examples of *Chætura*, is not placed in line with either portion of the main series, and does not appear to be a continuation of the coverts on the cubitus, like the similar small feather noted in some Kingfishers, etc. ; but it appears to be rather the single remaining feather of an obsolete row of median coverts. So we must consider the whole series of reversed coverts in the Swifts to be the major coverts, as in the Cuckoos.

The Passeriformes.—Now all the birds examined with regard to their reversed under coverts have been reviewed, excepting the Passeriformes. The large number of these examined (over four hundred examples belonging to 134 species) makes it necessary here to use a more concise method of treatment than with the other orders, and give first the general characters and afterwards particular modifications. This is, moreover, easy to do with the Passeriformes, on account of the great uniformity in their reversed under coverts, and the slight nature of such modifications as occur.

First, then, is given a general description that applies to all the Passeriform birds examined, without exception, and will not be repeated :—

Major under coverts present on the manus, ten in number, or often less, but never more ; not present on the cubitus as full-sized or functional coverts, but often found as small or rudimentary feathers, as in some of the Kingfishers. These rudimentary major under coverts in Passeriform birds are often larger at the distal end of the cubitus, next to the manus, and the first manual major under covert is often reduced in size ; so that there is a gradual transition from the full-sized ones on the manus to the rudimentary ones on the cubitus. The major under coverts are more closely joined to the remiges in this order than in any other birds. The overlap is always conforming throughout the series.

Median under coverts present on the cubitus, with an extra one at the carpal joint, making the number of the full series ten ; but one or two may be wanting at the proximal

end of the row—never at the distal end. They always have the contrary overlap.

The modifications now to be described, in the reversed under coverts of Passeriform birds, have to do exclusively with the greater or less reduction of the different parts of the major series.

Smithornis. Twelve examples, belonging to three species, examined. (Text-fig. 12.)

Major under coverts on the manus ten in number, but the first, next the carpal joint, generally reduced in size, sometimes so much reduced as to be a mere rudiment. Rudimentary major under coverts present in every case, on the

Text-fig. 12.

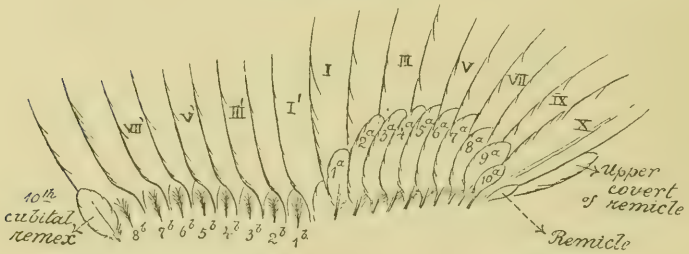

Diagram of the under wing-coverts of *Smithornis* with the median series removed.

i–x. Primaries; i′–vii′, etc. Secondaries.
1ª–10ª. Manual major u.w.c.
1ᵇ–8ᵇ. Rudimentary cubital major u.w.c.

cubitus, usually very small and downy, but sometimes those on the distal part large enough to have distinctly visible shafts.

Hirundo and *Psalidoprocne*. Thirteen examples, belonging to four species, examined.

Major coverts on the manus nine, the 10th, at the wing-tip, wanting (10th remex very small); the 1st, by the carpal joint, generally reduced in size. Rudimentary major under coverts present in every case on the cubitus.

Parisoma, Muscicapa, Alseonax, Artomyias, Pedilorhynchus, Hyliota, Bias, Platysteira, Diaphorophyia, Erythrocercus, Elminia, Trochocercus, Tchitrea, Chloropeta, Stizorhina. Seventy specimens, of 22 species, examined.

Major under coverts on the manus ten, the 1st sometimes reduced in size. Rudimentary major under coverts present on the cubitus, in most cases; but wanting, or only a few present, in the three specimens of *Elminia longicauda*; wanting in the two specimens of *Erythrocercus macalli*; wanting, or only a few present, in the six specimens of *Trochocercus nitens* (but the whole series present in all the five specimens of *Trochocercus nigromitratus*).

Campephaga quiscalina. Six specimens examined.

Major under coverts on the manus ten, the 1st sometimes reduced in size; rudimentary major under coverts always present on the cubitus.

Sigmodus rufiventris. Six specimens examined.

Major under coverts on the manus ten, the 1st small, as noted in one case, and probably so in others; rudimentary major under coverts present on the cubitus in every case, sometimes large and partly pennaceous, those next the carpal joint forming a transition to the full-sized coverts on the manus.

Nicator chloris and *N. vireo.* Seven specimens examined.

Major under coverts on the manus ten, all of the full size —at least generally; major under coverts on the cubitus entirely wanting in every case.

Pomatorhynchus, Laniarius, Chlorophoneus, Dryoscopus, Chaunonotus, Malaconotus. Twenty-eight specimens, of nine species, examined.

Major under coverts on the manus ten, usually all of the full size, but sometimes the first reduced; rudimentary major under coverts present on the cubitus in the greater number of cases, but wanting in *Pomatorhynchus* and *Malaconotus* (only one specimen of each examined) and wanting,

or only a few present, in some specimens of *Laniarius* and *Dryoscopus*.

Lanius mackinnoni. Two specimens examined.

Major under coverts on the manus ten ; rudimentary major under coverts present on the cubitus.

Dicrurus. Two specimens, belonging to two species, examined.

Major under coverts on the manus ten ; rudimentary major under coverts present on the cubitus.

Oriolus lætior. Two specimens examined.

Exactly as above, under *Lanius* and *Dicrurus*.

Lamprocolius, Onychognathus, Pœoptera Eight specimens, belonging to four species, examined.

Major under coverts on the manus ten ; rudimentary major under coverts present on the cubitus in every case, sometimes comparatively large ; in one specimen of *Lamprocolius splendidus* there were perfect feathers 13 mm. long, resembling the major under coverts on the manus except in size, and in having a little more downy margin or fringe on the vanes.

Parus funereus. Three specimens examined.

Major under coverts on the manus ten ; the 1st reduced in one specimen. Rudimentary major under coverts present on the cubitus, in one of the specimens large, and not differing greatly from the coverts of the same series on the manus, being only narrower and a little shorter, with somewhat looser vanes.

Malimbus, Ploceus, Amblyospiza, Pyromelana. Forty-nine specimens, of fifteen species, examined.

Major under coverts on the manus ten, the 1st very often reduced in size ; rudimentary major under coverts on the cubitus always present, though in some cases not all of them present.

Vidua serena. Four specimens examined.

Major under coverts on the manus nine, the 10th wanting; the 1st more or less reduced in size but present in all cases. Rudimentary major under coverts on the cubitus wanting, or only the first or most distal one present.

Spermospiza, Pyrenestes, Spermestes, Nigrita, Estrilda. Sixteen specimens, belonging to nine species, examined.

Major under coverts nine or eight, the 1st, next the carpal joint, being always absent, and the 10th, or most distal one, absent also in all of the smaller birds of this group—present only in *Spermospiza guttata* and *Pyrenestes ostrinus,* which are larger birds than the others. Rudimentary major under coverts on the cubitus always wanting. Thus it is seen that in the smaller Weaver-birds the major under coverts have undergone a further reduction than in any birds hitherto noticed.

Parmoptila woodhousei. Five specimens examined.

Major under coverts nine or eight, the 1st, or the 1st and 10th, being absent. Rudimentary major under coverts on the cubitus wanting.

Serinus punctigula. Seven specimens examined.

Major under coverts on the manus nine, the 10th wanting, the 1st reduced in size. Rudimentary major under coverts on the cubitus all present in one specimen, several of them present in another, only the first or most distal one present in a third, quite absent in the remaining four specimens.

Budytes flava. Three specimens examined.

Major under coverts on the manus nine, the 10th wanting; rudimentary major under coverts on the cubitus present in all the specimens.

Criniger, Bleda, Phyllostrephus, Andropadus, Pycnonotus, Ixonotus. Forty-six specimens, of fifteen species, examined.

Major under coverts on the manus ten, except in one specimen of *Andropadus virens,* which had only nine, the 1st

being absent; in some of the others the 1st was reduced in size. The presence or absence of the rudimentary major under coverts on the cubitus was found to vary among the members of this group, and even among individuals of some of the species: in *Criniger* they were always present; in *Bleda tricolor*, always absent; in *Phyllostrephus* and *Andropadus* there were generally none, or only one or two, found; in *Ixonotus guttatus* none, or only a few; in *Pycnonotus gabonensis* these rudimentary coverts were in some cases all present, in some a few only, and in some none. Where only a few were found, they were situated near one or the other of the extremities of the cubitus, those most frequently present in the partial series being the 1st, the 7th, and the 8th.

Turdinus. Eight specimens, belonging to three species, examined.

Major under coverts on the manus ten, except in one specimen, where the 1st was wanting; rudimentary under coverts either only a few present, or entirely wanting; where only a few were found, these were oftenest near the proximal end of the cubitus, or, sometimes, the most distal one of these rudimentary coverts (the 1st).

Callene, *Alethe*. Seven specimens, of three species, examined.

Major under coverts on the manus ten, the 1st sometimes reduced; rudimentary major under coverts on the cubitus present in every case.

Phylloscopus trochilus, *P. sibilatrix*, and *Sylvia*. Seven specimens examined.

Major under coverts on the manus ten, the 1st sometimes reduced in size; rudimentary major under coverts on the cubitus present in every case.

Cisticola, *Bathmedonia*, *Burnesia*, *Prinia*, *Calamocichla*, *Bradypterus*. Twenty-eight specimens, of nine species, examined.

Major under coverts on the manus ten, in *Calamocichla* and

Bradypterus (which contain the largest birds among the genera of this group), and in a few specimens belonging to the other genera; in most specimens of the other genera (comprising small birds), nine only, the first wanting. The first major under covert on the manus, when present, usually smaller than those following it. Rudimentary major under coverts on the cubitus wanting, except in one specimen of *Calamocichla rufescens*, where they were not only present but rather large.

Apalis, Euprinodes, Eremomela, Camaroptera, Macrosphenus, Sylvietta. Thirty-eight specimens, of nine species, examined.

Major under coverts usually nine, the 1st wanting, though in a few cases the first was present, and small or rudimentary, or even present and full-sized; most of the examples in which the first major under covert was found to be present belonged to *Sylvietta virens*. Rudimentary major under coverts on the cubitus wanting in every case.

Zosterops stenocricota. Four specimens examined.

Major under coverts nine, the 1st being present, but the 10th, at the tip of the wing, absent (and the 10th remex only 4 or 5 mm. long); the 1st major under covert, in one case, very small. Rudimentary major under coverts on the cubitus wanting.

Hylia prasina. Two specimens examined.

Major under coverts nine, the 1st wanting, or rudimentary. No rudimentary major under coverts on the cubitus.

Pholidornis rushiæ. Four specimens examined.

Major under coverts nine, the 1st wanting. No rudimentary major under coverts on the cubitus.

Anthreptes and *Cinnyris.* Thirty-seven specimens, of thirteen species, examined.

Major under coverts either all ten present but the 1st small or rudimentary, or only nine present, the first one absent. In several cases the first covert was entirely absent on one wing of the bird, but present and rudimentary on the other.

Rudimentary major under coverts usually absent on the cubitus, and when present, only a few were found, and those always at the proximal end next the elbow-joint.

Conclusions.

The account of the detailed examination of reversed under wing-coverts having now been finished, it remains to consider how far the several modifications discovered can be seen to be derived from each other and from a primitive type—in other words, to consider their bearing on a phylogenetic classification of birds. This is too difficult a matter to be gone into very extensively here; but enough may be said to show its importance and induce future study.

The most primitive type of reversed under coverts found in the birds examined is undoubtedly the one described first, as the normal type found in some birds that cannot all be considered as closely related to each other—the Ducks, Scissor-bills, Plovers, and Sandpipers,—in which there is a complete series of major, and a long series of median coverts, the former all with conforming, the latter all with contrary overlap. This most primitive type found, however, may fairly be supposed to be derived from one still more primitive, existing in the remote ancestry of birds, before the large flight-feathers became much differentiated from the ordinary covering feathers, in which both the series that have now become the reversed under coverts had the same uniform (conforming) overlap as the other rows that became the remiges and the large upper coverts, and both extended completely to the tip of the wing. The great development of the large flight-feathers would cause a reduction and partial disappearance of the less important of the two rows in question, the median under coverts, at the narrowest part of the wing, the tip. In no bird examined were the median under coverts found to extend much beyond half-way on the manus.

The assumption of the contrary overlap by the median coverts was the next step, and may be accounted for by a consideration of the way in which they best fulfil their office

of coverts. The function of coverts to the remiges is to close the insterstices between the quills and prevent the air from passing through, so causing leakage and loss of force in the wing-stroke in flying. This is accomplished more perfectly by two continuous rows of feathers overlapped in the opposite ways, than by two overlapped in the same way, since any accidental opening or separation, allowing air to pass, between two feathers in the one row, would tend to be continued in the same direction in the other row, were it overlapped in the same way ; but would tend to be stopped in the other row, were it overlapped in the contrary way. Thus it is essential to the best performance of their office that the feathers of these two rows be overlapped in opposite ways ; accordingly such a condition is found in all birds that make constant use of their wings in flight. In the Rails, both rows have the contrary overlap and are almost mixed together in one row ; in the Fowls, the small and almost functionless median under coverts were often found to have the conforming overlap: but birds of these groups fly comparatively little.

The next step or modification, leading further away from the primitive type, is the assumption of the contrary overlap by some of the major under coverts—generally those on the proximal part of the hand. This is very common among birds of many, or most, orders, and in some orders it is universal. It takes place, it will be noticed, on the central part of the wing where the resistance of the air in the wing-stroke is great, and at or near the place where the median coverts cease. Thus it is evidently to be accounted for in much the same way as is the contrary overlap of the median coverts, by the greater efficiency as coverts of feathers with the overlap in the opposite way to the remiges. That the contrary overlap in the major under coverts is not carried on out to the tip of the wing may be accounted for by the fact that on the narrow part of the wing near the tip the feathers are crowded so that the under coverts become sandwiched in between the remiges, and must necessarily have the conforming overlap. Thus the overlap of the

manual major under coverts is controlled by two opposite tendencies, that towards efficiency, and that towards conformity with the remiges resulting from crowding, the latter tendency acting most strongly near the tip of the wing. Hence the place of the change of overlap on the manus is indefinite, and great variation appears even among individuals of the same species, and sometimes between the two wings of one bird.

Conformity with the remiges as the result of crowded situation is evidently the explanation of the universally conforming overlap in the manual major under coverts of Passeriform birds ; for here the crowding is carried to the greatest extreme, the major under coverts being set close against the quills of the remiges, and no room is left for them to take the contrary overlap. In regard to the less degree of efficiency of these under coverts in Passeriform birds, which we should hardly expect to find in view of the high power of flight among them, it may be noted that in this order of birds the coverts in general are of less size and importance as compared with the remiges than in other orders, and efficiency has been secured through the broad and well-knit vanes of the remiges, the coverts being, as it were, neglected.

As intimated above, it seems significant that the major under coverts so often begin to assume the contrary overlap near the place where the median coverts cease—about the carpal joint,—as if it were essential that there should be everywhere one row overlapped in the way contrary to the remiges. According to this, we should expect that in birds having only the major series, the overlap would tend to become contrary. The Plantain-eaters have only the major under coverts, and they are always conforming ; but Plantain-eaters are not birds that make great and constant use of their wings in flight. Cuckoos, that fly more, have likewise only the major under coverts, and these have the contrary overlap, in many cases, not only on the manus but on the cubitus also. It is significant that among Accipitrine birds, all the numerous specimens examined of

the genus *Astur* had some of the major under coverts with the contrary overlap, while *Polyboroides* had all of these coverts conforming; for the more primitive *Polyboroides* has, for a Bird-of-Prey, a slow and laboured flight, while the small African Goshawks are the last thought in swift and skilful movement on the wing.

Further steps in the modification of the reversed under coverts from the primitive type are found in the reduction or disappearance of one or other of the two rows, in part or in whole; for the tendency of the evolution seems to be toward the neglect and loss of these feathers, in the process of perfecting the remiges. That the median series is incomplete on the manus in all the birds examined, and in the majority is reduced to one or two feathers, or none, on this part of the wing, has already been noticed. The median coverts have become very small in some groups, even on the cubitus, and in some entirely disappear.

Bearing in mind these two tendencies in the evolution of the wing, in respect to the reversed under coverts—that to reduction and that to the assumption of the contrary overlap,—we may arrange groups of birds in series showing the different stages. Thus, the Game-birds have the median coverts very small and of little use; in the Plantain-eaters they have quite disappeared; in the Cuckoos, not only have the median coverts disappeared, but the major coverts show a strong tendency to take their place functionally by assuming their contrary overlap. In this series it is the median coverts that are reduced, and disappear; another may be arranged in which that process is exemplified in the cubital major under coverts. The Doves have small cubital major under coverts, quite hidden by the median row; the same condition was found in the one species of Trogon examined; the Kingfishers show a still further reduction of these cubital major under coverts, and in some species (birds of small size) a total disappearance of them; the Bee-eaters retain only occasional vestiges of them; in the Barbets and Woodpeckers not even such vestiges were found. The Passeriform birds show all stages of reduction and

disappearance of the cubital major under coverts, but so irregularly that no series of families or genera can be formed, since great variation is found within genera and even species, some individuals having the rudimentary major under coverts quite large, while others of the same species have them very small or even absent. Yet in the Swallows these rudimentary coverts were always present, and also in some small groups of which but few representatives were seen; and in the small African "Warblers" related to *Cisticola*, and in the Sunbirds, they were nearly always wanting.

How far phylogenetic relationship may be inferred from such series of groups of birds as those given above is a difficult question. Of course it is quite impossible to suppose such relationship between some of the groups placed together in the above series, as between Doves and Coraciiform birds. But this fact does not destroy the force of the evidence of the reversed under coverts in favour of relationship in other cases. That the characters derived from these coverts cannot be used in all cases with logical precision is merely what must be admitted of all characters used in classification whatever. Furthermore, where so much uniformity of type is found in the reversed under coverts in undoubted large groups of birds, a departure from this uniformity is a real ground for doubt about the inclusion of some groups in the larger groups in which they have been sometimes placed. The Owls and the Nightjars, for instance, have the reversed under coverts little modified from the primitive or "normal" type, and not showing the slightest tendency towards the very peculiar and characteristic type seen in the Picarian birds (Kingfisher–Woodpecker group). So also the Parrots, with the two rows of these coverts well developed, show no tendency towards the type found in Plantain-eaters and Cuckoos, in which the median coverts have disappeared, though the Fowls, with their much reduced median coverts, do show such a tendency. It may be added that the reversed under coverts of the Swifts, in the few examples seen, do not appear derivable from the type found in the Kingfisher–Woodpecker group—or from any other special type observed.

But the study of the reversed under coverts will have to be carried much further before conclusions bearing on the classification of birds can be safely derived therefrom.

In conclusion, the author of this paper is glad to acknowledge the encouragement, advice, and help received from Mr. W. R. Ogilvie-Grant in the putting together of the records of his observations in a form for publication. The observations themselves were made quite independently and alone, the idea of making them having been derived from reading Mr. Pycraft's paper referred to in the introduction, and afterwards that of Sundevall.

XXIX.—*Notes on recently described Races of Siamese and Malayan Birds, with a Description of one new Race.*

By Herbert C. Robinson, M.B.O.U., and C. Boden Kloss, M.B.O.U.

Within the last few months a considerable number of races of Malayan and Siamese birds have been described in various periodicals, English and Foreign, by E. C. Stuart Baker, Count Nyls Gyldenstolpe, Dr. E. Hartert, H. Oberholser, and Lord Rothschild.

As the collections of birds from these regions that are either embodied in the collection of the Federated Malay States Museums, and collected by us, or have passed through our hands, are very large indeed, while in some instances the races are actually founded on duplicates from our collections, some remarks on certain of these species may possibly be of interest.

In the first place, it may not be amiss to observe that in some cases a certain laxity is apparent in the quotation of precise type-localities, though this, of course, is not entirely to be laid to the door of the describer. Localities which are quite familiar to the original collector, who in many cases may have collected entirely for his own edification, and which may even be readily traceable by local residents, are very frequently not to be found in any map at